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COMMENTS ON
CALFED ECOSYSTEM RESTORATION PROGRAM PLAN
VISION FOR ECOSYSTEM MONITORING

Via e-mail

August 16, 1997

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Dear Rick:

At the August 6, 1997 meeting of the CALFED Water Quality Program, you and Bellory Fong presented a discussion on the Comprehensive Monitoring, Assessment, and Research Program. It was indicated that there was interest in receiving comments on the Volume III: *Ecosystem Restoration Program Plan, Vision for Ecosystem Monitoring*, Review Review Draft: July 16, 1997 that was distributed at that meeting. Overall, there are some problems with descriptions of parameters and their use as well as some of the proposed monitoring program components. Please find presented below my comments on this program.

Page 101, second column states that the Sub-Program purpose is *"To routinely monitor the basic water quality variables (listed below) that define the fundamental conditions of aquatic habitat in the Bay-Delta system."* CALFED should be careful to not get into the trap of routinely monitoring selected parameters because this is traditionally done, but intelligently monitor focusing the resources available on addressing issues that are of potential importance to Delta ecosystems and water quality.

Discussions of "Sub-Program Element Descriptions (parameters)" for temperature should be expanded to include rate of temperature change. The rate of temperature change is as important, if not more important, in some situations than the absolute temperature. Under "Salinity" the word is "specific conductance," not conduction, and it should read: "Specific conductance is a more appropriate measure of salt content than salinity in freshwater systems."

Under "Chlorophyll concentration," there will be many who will not understand what "traditional box" means.

Under "pH" the statement: *"A quantitative expression for acidity or alkalinity of the area sampled"* is in error. pH is not a measure of acidity or alkalinity; they are different parameters related to buffer capacity. pH is a measure of the hydrogen ion activity in the water sample.

Page 102, under "Organic Carbon," states that *"Organic Carbon - Provides information on sources and fluxes of the primary support of the estuarine food chain."* This statement, as well as other statements made by various CALFED staff and others, shows a lack of understanding of the characteristics of organic carbon. A number of years ago I wrote an invited review on this issue in which I pointed out what was well-known then and is still well known today, that most of the organic carbon in aquatic systems is not suitable food; it is the residues after bacteria and other organisms have extracted the useful components from the organic carbon. Many waterbodies have from two to 10 mg/L organic carbon, much of which is dissolved and is inert. It does not serve as a food base for any organism; it is a residue, much as humus in soils is a residue left over from previous metabolic activity. CALFED needs to begin to address the issue of what forms of organic carbon are in fact useable as food and refine the general statements about how organic carbon extracted from Delta Islands as part of farming activities is an important food source for aquatic life. Much of what is extracted from the peat soils is non-useable by bacteria and other forms of aquatic life as food.

Page 103, under "Key Focused Research Areas," mentions in item 2: *"Development of a plan for storage, retrieval and analysis of water quality data."* I have recently provided guidance on the approach that, based on my experience, should be considered for the Sacramento River Watershed Program data storage and retrieval system. Those in CALFED concerned with this may want to review the comments of the workgroup that is addressing these issues for the Sacramento River system.

Page 103, "Key Focus Research Areas," item 3: *"Development of a computer model or models to predict water quality conditions in unmonitored areas and evaluate restoration scenarios."* That approach is dangerous and portrays a blind faith in the ability of computer modeling to provide useful information. Computer models of the type that are available today, relating physical, chemical and biological characteristics of waterbodies have limited predictive capability to assess the impact of altering load driving parameters on the response of an aquatic system. Modeling of the type that is typically done today involving physical, chemical and biological characteristics of waterbodies is largely a mathematical game that has little or no utility in predicting impacts of constituents and are not reliable for evaluating altered loads of constituents through CALFED restoration programs. The way to make that type of assessment is through measurements - proper monitoring. It can not be made through modeling. Mathematical models are useful in organizing thoughts regarding understanding the system. They are not useful for predicting or evaluating a system, and they can certainly never predict the water quality characteristics of unmonitored areas. Such areas have to be monitored.

Page 104, top of the first column, "Sub-Program Purpose," states *"To monitor levels of contaminants potentially harmful to aquatic life, system-wide, in water, sediments, and biota for documenting trends in contamination levels, bioaccumulation, and identifying potential biological effects and to identify time periods and locations where specific contamination reduction efforts should be focused."* While that objective is appropriate, the program that is proposed will fall short of that objective since the monitoring that has been done, or is being done, is not utilizing information available on what is known about how chemical constituents impact aquatic life. It appears that the CALFED monitoring program, as it is formulated, will be another program that will generate massive amounts of data, at great expense, where in the end the data will be filed in a file cabinet (computer data storage based system) and will become more of what is known as "file cabinet fodder" since it does not provide a significant amount of useful information on the key issues that need to be addressed.

Under "Sub-Program Element Descriptions," item 1 mentions herbicides, pesticides and metals as the parameters to be monitored. In collaboration with existing programs, the monitoring of pesticides, herbicides and metals will not provide information on anything other than the concentrations present as a result of the fact that it is not possible to relate concentrations measured by various techniques commonly used in monitoring programs to water quality impacts. The first step in monitoring of the Delta should not involve throwing large amounts of money at monitoring various conventional pollutants, but should instead focus on finding real water quality use impairments in the Delta that need to be managed. For example, copper or, for that matter, many other constituents in the Delta is not a problem per se, unless it affects the numbers, types and characteristics of desirable forms of aquatic life. The monitoring, therefore, must be focused on finding real water quality use impairments determining the cause of the use impairment and the constituents responsible. Based on this information, through forensic analysis, the monitoring program should determine the source of the constituents responsible for causing the use impairment. Rather than measuring chemicals and trying, unsuccessfully, to extrapolate to impacts, focus on impacts and then determine through relatively simple, straight-forward procedures that have been available for many years, the significance, cause and source of the constituents responsible.

I have been involved in water quality monitoring programs throughout my over 37 year professional career. I have helped design major monitoring programs for components of the Great Lakes and have been involved in many large, as well as small, scale studies, where monitoring was a key component. It became clear to me several years ago that the traditional approach, which is the approach that CALFED is proposing, has limited utility for monitoring and helping to identify and manage real water quality use impairments that are of concern to the people who voted for the restoration of the Delta. Because of the shortcomings in conventional monitoring, Dr. Anne Jones-Lee and I have developed what we call Evaluation Monitoring, which changes the focus from ambient water monitoring or source monitoring to problem identification and characterization monitoring. Extensive information on Evaluation Monitoring is available from my web site (http://members.aol.com/gfredlee/gfl.htm), which includes summary papers and an over 100-page guide devoted to implementing this approach on a group of waterbodies. These papers and reports are available as downloadable files, and I would be happy to answer any questions about them.

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It is my recommendation that a significant part of CALFED's monitoring efforts be specifically focused on developing and implementing an Evaluation Monitoring program for the Delta. This will not be a routine monitoring program of the type described in the Ecosystem Restoration Program Plan, Vision for Ecosystem Monitoring draft, July 16, 1997. That proposed program will cost large amounts of money and fall far short of providing the information needed to restore the Delta.

Evaluation monitoring is not simply some toxicity measurements or bioaccumulation measurements or fish condition measurements which are added on as part of the routine monitoring. Such problem identification issues such as toxicity, bioaccumulation, and fish condition, become the focal point of the monitoring. Do not measure heavy metals and try to extrapolate to toxicity. Measure toxicity, find out what it is due to. If it is due to a heavy metal, what are the sources of the toxic components of heavy metals that caused the toxicity in the system of concern?

Page 104, second column, second paragraph states, *"Toxicity monitoring has the potential to be logistically difficult and expensive."* This is a typical statement made by those who are not familiar with toxicity monitoring. Toxicity monitoring is far less expensive and easily implemented than properly conducted chemical monitoring. With respect to the SFEI bioaccumulation monitoring, mention should be made here that the Sacramento River Watershed Program has also developed a bioaccumulation monitoring program that is being implemented this summer.

The statement is also made about using the State's Mussel Watch program in the Delta monitoring. Great caution must be exercised in using Mussel Watch data. It is not reliable for identification of problems unless people eat mussels or freshwater clams. Mussel Watch data is subject to many factors that are not related to the available concentrations of constituents in the waterbody. Further, it is not possible to relate Mussel Watch bioaccumulation data to concentrations of constituents in aquatic life of concern to people who use the organisms as food.

Page 104, item 4, "Fish Condition Monitoring" is an area that needs attention for problem identification, although it will almost certainly prove to be frustrating for many years because of the difficulty in trying to relate morphological changes in fish to environmental factors. A number of groups have been working on this problem for many years with limited success. It does not mean it should not be done. It should be understood, however, that fish condition monitoring is necessary for problem identification, but will not likely yield useful results in the near term other than problem identification.

Page 105, "Key focused-Research Topic Areas," mentions in item 2, *"Pilot-level water and sediment contaminants ..."* The issue of sediment monitoring for chemical constituents and toxicity is an issue that I have focused on for over 30 years. I have conducted over $2 million in research on this topic and have published over 50 papers and reports dealing with various aspects of it. While there is need for studies on sediment impacts on water quality, to conduct a routine monitoring program of chemical concentrations of constituents and sediments is of limited utility. Even toxicity measurements in sediments, while far more reliable than chemical concentration measurements for

identifying toxic conditions, still do not provide interpretable results with respect to the significance of chemical constituents in sediments that impact the beneficial uses of the waterbody in which the sediments are located. Last fall I presented an invited paper, Lee, G.F. and Jones-Lee A., "Evaluation of the Water Quality Significance of the Chemical Constituents in Aquatic Sediments: Coupling Sediment Quality Evaluation Results to Significant Water Quality Impacts," In: WEFTEC '96, Surface Water Quality and Ecology I & II, Vol 4, pp 317-328, Proc. Water Environ. Fed. Annual Conference (1996), in which I discussed the interpretation of sediment toxicity issues relative to water quality - use impairment impacts and natural toxicity of sediments. This paper is available as a downloadable file from my web site (http://members.aol.com/gfredlee/gfl.htm).

Based on my experience, CALFED needs to carefully formulate a sediment quality investigation program that properly incorporates what is well known in the field today with how chemical constituents in sediments potentially impact the beneficial use of a waterbody. CALFED needs to develop a program that begins to address the highly significant data gaps that exist between measurement of a characteristic of a sediment and the beneficial use of the waterbodies in which the sediments are located. CALFED water quality sediment programs should be based on an effects-based approach rather than a chemical approach. The US EPA and Corps of Engineers, as part of managing open water disposal of contaminated dredged sediments, adopted an effects-based approach in the late 1970s. The approach has been reaffirmed a number of times by both agencies. It has been through public Federal Register review and is an effective, reliable approach for assessing the potential impacts of chemical constituents in sediments. There are peer review guidance manuals on various testing procedures that are used to evaluate the effects of constituents in sediments that are jointly developed by the US EPA and Corps of Engineers. This is a far more reliable approach than the chemically-based approach. While bureaucratically simpler to implement, the chemically-based approach is technically invalid and can readily result in massive waste of public and private funds in sediment constituent control that will have no impact on the beneficial uses of the waterbody in which the sediments are located. I have published a number of papers on these issues which are available from my web site.

Page 105, under "Key Focused-Research Topic Areas," item 3, *"Development and implementation of biomarkers..."* indicates that CALFED plans to devote resources to this area. CALFED should proceed cautiously with devoting resources to trying to use biomarkers as a tool to identify adverse impacts of chemicals to aquatic life. The biomarker concept and approach has been around since the late 1960s. I have been following the use of biomarkers for assessing impacts of chemicals on aquatic organisms since the 1960s. While this is an area of interest, it is not one that should receive a lot of CALFED funding. A couple of years ago the ASTM held a three day conference devoted to a review of what is known about the reliability of biomarkers as an indicator of water quality/ecosystem impacts of chemical constituents, this resulted in the symposium proceedings entitled, *Environmental Toxicology and Risk Assessment: Biomarkers and Risk Assessment*, Fifth Volume, STP 1306 (1996). The consensus of the group at the meeting was that while biomarkers are of interest, they are years away from being a reliable tool to evaluate the potential for chemical constituents to adversely impact aquatic organisms, ecosystems or water quality. Basically, biomarkers are now only useful to indicate that there has been an exposure to a

chemical. What the biomarker response means is largely unknown and is not likely to be elucidated in time to be of much value to at least the first 10 years of CALFED.

Page 105, right column, Sub-Program Element Descriptions, the development of wetlands and riparian habitat. As an individual who did some of the first, if not the first work ever done on chemical characteristics of fresh water wetlands and who has been involved in wetlands water quality issues over the last 30 years, I am strongly supportive of work in this area. However, great caution must be exercised to be sure that the monitoring programs properly evaluate the chemical/biochemical characteristics of wetlands. There is considerable misconception about these areas and especially how such areas handle potential pollutants. Generally wetland areas tend to be able to detoxify, immobilize or otherwise render inert large amounts of potentially harmful chemical constituents. They can, however, be overloaded. Further, in evaluating wetlands, it is important to look at the annual cycle and not just the growing season. Large amounts of materials that are taken up by vegetation during the growing season are released in short periods of high flow during the late winter/early spring.

Another area of concern is the use of contaminated dredged sediments for shallow water habitat development. I have submitted a proposal to CALFED to work with CALFED management and others in developing a program where contaminated dredged sediments could potentially be used for shallow water habitat development. This will require an intensive monitoring program to be certain that the contaminants in the sediments do not adversely affect aquatic as well as terrestrial life and other aspects of Delta water quality. If the proposal is funded, I will be able to assist in these areas as an active participant. As discussed in the proposal, I have considerable experience and expertise in wetlands development from contaminated sediments through the work I have done over the years with the Corps of Engineers in their Dredged Material Research Program.

Page 106, right column, Sub-Program: Estuary Primary Productivity and Nutrient Monitoring indicates that *"particulate, dissolved, and total organic carbon"* will be measured. In addition, there is need to characterize the organic carbon with respect to its suitability as a food source. Much of the organic carbon that is present in the Delta and in many aquatic systems is a residue after bacteria, etc. have made use of all the degradable components. Even a simple BOD test would be useful to determine how much of the organic carbon is in fact degradable/useable as food.

The bulleted items under the Sub-Program include dissolved nitrogen. In addition, soluble orthophosphate, organic nitrogen and total phosphate should be measured. While, in general, the Delta primary production appears to be limited by available nitrogen in the form of nitrate and ammonia, there is potential for some parts of the Delta and estuary to have surplus nitrate and ammonia compared to available phosphorus. By measuring the soluble orthophosphate and the total phosphate, it is possible to predict the algal available phosphorus. This is of potential importance since it may be possible to limit excessive algal growth in some parts of the Delta by limiting the phosphorus input to the Delta from domestic wastewater sources. Development of this type of data will enable a proper evaluation of this approach to be made.

In addition to measuring chlorophyll, presumably from planktonic algae, there is also need to assess the amount of attached algae and macrophytes. Some parts of the Delta are experiencing prolific growths of non-planktonic aquatic plants. It is important to gain some information on this biomass since it will directly compete with the planktonic algae for nutrients. Someone highly familiar with data of this type should review the USGS data that has been collected over the years as part of their standard cruises to determine what additional information is needed to understand the issues. This is an area in which I could be of assistance if there is interest.

Page 107, under "Key Focused Research Areas," there is need to examine the productivity of algae attached to surfaces. Also, since wetland areas can have appreciable nitrogen fixation occur on the surface of macrophytes and emergent plants, consideration should be given to assessment to nitrogen fixation in the Delta as a source of nutrients.

In the 1970s, I was asked by the US EPA to develop a water quality monitoring program for hazardous chemicals in the Great Lakes. When I moved back to California in 1989, I updated that program and expanded its scope in the form of a report entitled, "Guidance for Conducting Water Quality Studies for Developing Control Programs for Toxic Contaminants in Wastewaters and Stormwater Runoff" (1992). This report discusses many of the key issues that need to be considered in formulating a technically valid, cost effective water quality and ecosystem monitoring program for the Delta. The report is available as a downloadable file from my web site. Another source of information on developing monitoring programs is the National Research Council's "Assessment of Marine Monitoring: Managing Troubled Waters," 1990. It also provides guidance on the issues that should be considered by CALFED in formulating the Delta's Water Quality Monitoring Program.

Over the past year and a half, I have been active in the Sacramento River Watershed Program where a considerable part of my time has been devoted to discussion of issues that should be considered in formulating a water quality monitoring program for the Sacramento River system. Many of the same issues that have been addressed as part of that system have direct applicability to the Delta system as well. A number of my comments on issues that should be considered in developing a comprehensive monitoring program for the Sacramento River system are available from my web site.

Overall, I feel that there is need for further refinement of the Ecosystem Restoration Program Plan Vision for Ecosystem Monitoring to address the various issues I have raised in these comments. I would be happy to discuss these with anyone interested and be of assistance to the extent that I can. Please contact me if you have questions on these comments.

Sincerely yours,

G. Fred Lee, PhD, DEE

Copy to: Lester Snow, J. Bruns, C. Foe, V. Connor, W. Croyle